SCOPE OF CLAIMS

1. A combined machining equipment for steel tubes, having a steel tube machining apparatus for machining an end of a steel tube with replaceable machining heads, a steel tube holding apparatus having a replaceable clamp chuck for gripping an outer surface of said steel tube from opposite sides and holding the steel tube in a machining position, and a common mount, characterized in that

said steel tube machining apparatus has a main shaft which is movable reciprocally and rotatable by a drive motor, an auxiliary shaft disposed coaxially with said main shaft and housed in a hollow portion of said main shaft, said auxiliary shaft being fixed against rotation with respect to said main shaft and slidable axially, a flange disposed on a distal end of said main shaft for mounting a machining head thereon, a mount base disposed on a distal end of said auxiliary shaft for mounting a machining head that moves radially thereon, and a slide frame with said main shaft rotatably held thereon;

said common mount holds said slide frame for sliding movement in directions of said steel tube holding apparatus, and firmly interconnecting said steel tube holding apparatus and a hydraulic cylinder for sliding said slide frame; and

the machining heads are mounted on said flange and said mount base for machining the end of said steel tube upon rotation of said main shaft and axial movement of at least one of said main shaft and said auxiliary shaft.

2. A combined machining equipment for steel tubes according to claim 1, wherein said steel tube machining apparatus serves to perform a flaring process to bend the end of said steel tube outwardly into a flange, said steel tube machining apparatus has a first machining head for spreading the end of said steel tube to an intermediate first flanged position and a second machining head

for pressing the end of the steel tube which has been spread to the first flanged position to a predetermined flanged position;

said first machining head comprises a conical roller freely rotatable about its own central axis and is mounted on said mount base on the distal end of said auxiliary shaft as a first machining head unit held with said central axis tilted on a plane including the axis of said main shaft such that the outer generator on the conical surface of said first machining head which is held in contact with the end face of said steel tube is kept at an angle corresponding to said first flanged position, said first machining head being rotatable about the axis of said steel tube and movable forwardly while in contact with the end face of said steel tube upon rotation and forward movement of said main shaft; and

said second machining head comprises a conical roller freely rotatable about its own central axis and is mounted on said flange of said main shaft as a second machining head unit held with said central axis tilted on the plane including the axis of said main shaft such that the outer generator on the conical surface of said first machining head which is held in contact with the end face of said steel tube is kept perpendicularly to the axis of said main shaft, said second machining head being rotatable about the axis of said steel tube and movable forwardly while in contact with the end face of said steel tube upon rotation and forward movement of said main shaft.

3. A combined machining equipment for steel tubes according to claim 2, wherein said steel tube machining apparatus comprises:

said main shaft having the flange on a front end thereof for mounting said second machining head unit thereon, said main shaft having a rear end coupled to a rotational shaft of a drive motor for rotation by said drive motor;

said auxiliary shaft having the mount base on a front end thereof for mounting said first machining head unit thereon to allow said first machining

head unit to slide in a direction perpendicular to the central axis of said main shaft, said auxiliary shaft being fitted in an inner bore of said main shaft and said flange for sliding movement along the central axis of said main shaft and rotation in unison with said main shaft; and

said slide frame having a front slide frame and a rear slide frame, said main shaft being rotatably held by bearings on the front slide frame and the rear slide frame, said drive motor and an end of a third hydraulic cylinder for sliding said auxiliary shaft with respect to said main shaft being fixed to said rear slide frame, said slide frame having sliders on opposite sides thereof which are held in engagement with guide rails of said common mount and slidable along the central axis of said main shaft;

said steel tube holding apparatus comprises a clamp chuck replaceable depending on the diameter of said steel tube for gripping an outer surface of the steel tube from opposite sides thereof, said clamp chuck being fixable by a first hydraulic cylinder;

said common mount has a front frame, a rear frame, left and right pairs of side frames, and two base frames, said front frame and said rear frame being connected to each other by said left and right pairs of side frames and said two base frames, said steel tube holding apparatus being fixed to said front frame, said guide rails which are engaged by said sliders of said slide frame being mounted on said side frames, with a second hydraulic cylinder having a front end fixed to said slide frame and a rear end fixed to said rear frame, said base frames supporting thereon a motor, a hydraulic unit, and a control console;

said first machining head comprises a conical roller freely rotatable about its own central axis and is mounted on said mount base of said auxiliary shaft as a first machining head unit held with said central axis tilted on a plane including the axis of said main shaft such that the outer generator on the conical

surface which is held in contact with the end face of said steel tube is kept at an angle corresponding to said first flanged position, for sliding movement perpendicular to the axis of said main shaft in order for said generator of said first machining head to face the end face of said steel tube to be machined which has a diameter within a predetermined range, said first machining head being capable of spreading the end of said steel tube held in contact therewith through an angle corresponding to said first position upon forward movement and rotation of said main shaft through said auxiliary shaft when said auxiliary shaft is in a forward position with respect to said main shaft; and

said second machining head comprises a conical roller freely rotatable about its own central axis and is mounted on said flange of said main shaft as a second machining head unit held with said central axis tilted on the plane including the axis of said main shaft such that the outer generator on the conical surface which is held in contact with the end face of said steel tube has a length corresponding to the end face of said steel tube to be machined which has a diameter within a predetermined range, and is perpendicular to the axis of said main shaft, said second machining head being capable of pressing and deforming the tip end of said steel tube held in contact therewith to said predetermined flanged position upon forward movement and rotation of said main shaft when said auxiliary shaft is in a retracted position with respect to said main shaft.

4. A combined machining equipment for steel tubes according to claim 2, wherein said drive motor for rotating said main shaft comprises an electric motor with a speed reducer mechanism.

5. A combined machining equipment for steel tubes according to claim 2, further comprising a flared surface grinding unit for grinding the end face of said steel tube which is pressed and deformed by said flaring process, said flared surface grinding unit being disposed on said flange of said main shaft adja-

cent to said second machining head unit, and having a flared surface grinding cutter slidable depending on a change in the diameter of said steel tube, said flared surface grinding cutter having a cutting edge extending perpendicularly to the axis of said main shaft and substantially aligned with the surface of said steel tube which is contacted by said second machining head, said flared surface grinding unit being held by a spring and mounted in a support hole defined in said flange, wherein said cutting edge of said flared surface grinding cutter is held in contact with the end of said steel tube which is pressed and deformed by said second machining head to grind the deformed end of said steel tube upon rotation of said main shaft in a predetermined direction.

6. A combined machining equipment for steel tubes according to claim 2, wherein the mount base of said first machining head unit includes two mount bases facing each other across said axis in a diametrical direction of the flange of said main shaft, further comprising a flexure prevention machining head unit mounted in place of said first machining head unit on one of said mount bases, said flexure prevention machining head unit having a flexure prevention machining head disposed on a distal end thereof and having a cylindrical shape parallel to the axis of said main shaft, wherein while said flexure prevention machining head unit is positionally adjusted on said mount base to keep a side edge of the cylindrical flexure prevention machining head in contact with an inner surface of the end of the steel tube to be flared, the tip end of said steel tube is spread by said first machining head and pressed and deformed to the flanged position by said second machining head, for thereby preventing the inner surface of the steel tube close to the flanged end thereof from being flexed inwardly.

7. A combined machining equipment for steel tubes according to claim 1, further comprising a groove machining attachment mounted on said mount base of said auxiliary shaft for machining a welding groove in the tip end of

said steel tube, said groove machining attachment having a groove machining tool disposed on a distal end thereof and having an inclined cutting edge on a distal end thereof, wherein while said groove machining attachment is positionally adjusted on said mount base to keep said cutting edge in contact with the tip end of the steel tube fixed to a clamp chuck, said main shaft is rotated and moved forwardly to cause said cutting edge to cut the tip end of said steel tube to form a groove therein.

8. A combined machining equipment for steel tubes according to claim 1, further comprising a lining cutting attachment mounted on said mount base of said auxiliary shaft for peeling off a lining attached to inner and outer surfaces of the steel tube, said lining cutting attachment having a lining cutting cutter disposed on a distal end thereof and having a cutting edge disposed on either an inner surface or an outer surface thereof parallel to the axis of said main shaft, wherein while said lining cutting attachment is positionally adjusted on said mount base to keep said cutting edge of the lining cutting cutter in contact with either the inner surface or the outer surface of said steel tube, said main shaft is rotated and moved forwardly to cause said cutting edge to peel off the lining on said steel tube.

9. A method of machining a steel tube by performing a flaring process to bend an end of the steel tube outwardly to form a flange thereon perpendicularly to a central axis of the steel tube, using a combined machining equipment for steel tubes, so that ends of two steels can be fastened to each other by joining loose flanges having inner surfaces slidable along outer wall surfaces of the steel tubes, comprising the steps of:

fixing the steel tube to be machined in a predetermined position in said combined machining equipment with a clamp chuck of a steel tube holding

apparatus such that the central axis of the steel tube is aligned with a central axis of a main shaft;

fixing a first machining head in a position, corresponding to a machining position, on a mount base disposed on a distal end of an auxiliary shaft which is slidable back and forth with respect to the main shaft and fixed against rotation with respect to the main shaft, said first machining head comprising a freely rotatable conical roller mounted on said mount base, said conical roller having a conical surface having a generator kept at an angle corresponding to a first machined position;

moving forwardly said auxiliary shaft to a foremost position with respect to said main shaft, and moving forwardly said main shaft while in rotation to cause said first machining head to spread the end of said steel tube to said first machined position;

retracting said auxiliary shaft to a rearmost position with respect to said main shaft, and moving forwardly said main shaft while in rotation to cause a second machining head, which comprises a freely rotatable conical roller mounted on a flange on a distal end of said main shaft, with a generator perpendicular to the axis of said main shaft, to press and deform the end of said steel tube to a predetermined flanged angle; and

opening said clamp chuck of said steel tube holding apparatus to remove said steel tube which has been flared.

10. A method of machining a steel tube according to claim 9, further comprising the step of:

after the end of said steel tube is pressed and deformed to said predetermined flanged angle by said second machining head, rotating said main shaft in an opposite direction to rotate a flared surface grinding cutter in a grinding direction to grind the end face of said steel tube which has been flared, said

flared surface grinding cutter being disposed on the flange of said main shaft adjacent to said second machining head unit and having a cutting edge extending perpendicularly to the axis of said main shaft and substantially aligned with the surface of said steel tube which is contacted by said second machining head, said cutting edge being pressed toward said steel tube.

11. A method of machining a steel tube according to claim 9, further comprising the steps of:

replacing one of two sets of first machining heads on said first machining head mount base with a flexure prevention machining head unit having a flexure prevention machining head on a distal end thereof which is of a cylindrical shape parallel to the axis of said main shaft; and

positionally adjusting said flexure prevention machining head unit on said first machining head mount base to bring a side edge of the cylindrical flexure prevention machining head into contact with an inner surface of the end of the steel shaft to be flared;

wherein said end of the steel shaft is flared while the side edge of the cylindrical flexure prevention machining head is held in contact with the inner surface of the end of the steel shaft to be flared.

12. A method of machining a steel tube to form a welding groove in a tip end of the steel tube, comprising the steps of:

fixing the steel tube to be machined in a predetermined position in said combined machining equipment with a clamp chuck of a steel tube holding apparatus such that the central axis of the steel tube is aligned with a central axis of a main shaft;

fixing a groove machining tool having an inclined cutting edge on a distal end thereof to a mount base such that said cutting edge faces the end of said steel tube, said mount base being disposed on a distal end of an auxiliary

shaft which is slidable back and forth with respect to the main shaft and fixed against rotation with respect to the main shaft;

moving forwardly said auxiliary shaft to a foremost position with respect to said main shaft, and moving forwardly said main shaft while in rotation to cause said cutting edge to cut the end of said steel tube to form a groove therein; and

opening said clamp chuck of said steel tube holding apparatus to remove said steel tube with the groove formed therein.

13. A method of machining a steel tube to peel off a lining attached to the steel tube, comprising the steps of:

fixing the steel tube to be machined in a predetermined position in said combined machining equipment with a clamp chuck of a steel tube holding apparatus;

fixing a lining cutting cutter having a cutting edge disposed on either an inner surface or an outer surface thereof parallel to the axis of said main shaft, to a mount base disposed on a distal end of an auxiliary shaft which is slidable back and forth with respect to a main shaft and fixed against rotation with respect to the main shaft, such that said cutting edge is held in contact with either the inner surface or the outer surface of the end of said steel tube; and

bringing said cutting edge of said lining cutting cutter into contact with either the inner surface or the outer surface of the end of said steel tube, and rotating and moving forwardly said main shaft to cause said cutting edge to peel off a lining attached to either the inner surface or the outer surface of said steel tube.